b.) Remarks

Claims 1-3 are pending in this application. Claims 22-36 have been withdrawn. New Claims 37-41 have been added to alternatively define Applicant's invention.

Claim 3 has been amended to provide antecedent basis for the element "iron powder" in line 3 of the claim.

Claims 1-3 were rejected under 35 U.S.C. 103(a) over Gault (US 6,303,891) and further in view of Marshall et al. (US 4,800,131). This rejection is respectfully traversed for the following reasons.

It has been long known in the welding industry that using solid wire electrodes with 100% Ar shielding atmosphere has produced poor welding conditions, instable arc and, as a result, poor welds. Therefore, a mixture of Ar and an oxidizing gas, such as CO_2 and O_2 has been used for acceptable welding conditions. Similarly, it has been accepted in the industry that pure Ar shielding atmosphere does not work in metal core wire gas shielded arc welding processes. For example, AWS A5.28 Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding (enclosed with this response) shows that the carbon steel electrode welding specification recognizes only 100% CO_2 as a shielding gas or Ar with 20-25% of CO_2. This specification recognizes Ar with as little as 1-5% oxygen, but in all such welding specifications the percentage of an oxidizing gas component should be no lower than 1%.

The second page of the same AWS specification says in the footnote that the only shielding atmospheres that work with solid, cored or metal cored electrodes are gas blends of Ar and an oxidizing gas. The third page of the same AWS specification shows Annex A6.2, which discusses the need for oxygen (with a 1% minimum of O_2 or a 5% minimum of CO_2) in the shielding atmosphere to obtain a spray transfer.

According to other AWS classifications of electrodes with specific shielding gases (A5.18 for carbon steel, A5.28 for low-alloy steel and A5.9 for stainless steel), it

was determined that in order to use Ar shielding gases with these electrodes, no less that 1% of either O_2 or CO_2 was required to obtain steady arc transfer. Even solid electrodes manufactured today have a very unstable arc transfer when welded with pure argon gas shielding.

In the Gault patent cited by the Patent Office, the same traditional oxidizing shielding atmosphere of a mixture of Ar is disclosed. For example, the oxidizing shielding mixtures of up to 96% of Ar with 3% of CO_2 and 1% of O_2 (abstract, Table 2), or up to 98-99% of Ar with 1-2% of O_2 (Table 1) are disclosed.

The invention as in Claim 1 and its dependent claims is directed to the Applicants' discovery that a <u>non-oxidizing</u> pure Ar atmosphere actually works with metal core electrodes in a GMAW process, producing a stable arc, reducing silicate islands and providing reasonable penetration. To the contrary, the Gault patent, as well as all of the above-referenced AWS specifications of the state of the art, teach away from using the non-oxidizing Ar shielding atmosphere. Therefore, Claim 1 cannot be obvious either over Gault alone or over a combination of Gault with the Marshall patent.

With regard to dependent Claim 2, Applicants points out that the shielding atmosphere claimed in that Claim remains non-oxidizing. The listed residual amounts of gases listed in that Claim could be there due to the fact the shielding Ar gas could contain residual impurities. Applicants have established that the residual amounts of less than 1% do not change the non-oxidizing nature of the Ar shielding atmosphere. Therefore, dependent Claim 2 cannot be obvious either over Gault alone or over a combination of Gault with the Marshall patent.

With regard to dependent Claim 3, Applicants assert that it cannot be obvious either over Gault alone or over a combination of Gault with the Marshall patent, since it inherits the element of a <u>non-oxidizing</u> pure Ar atmosphere in the GMAW process of metal core wires.

New Claims 37-41 depend off allowable Claim 1 and are allowable.

Turning now to the obviousness-type double patenting rejection of Claims 1-2 rejected over claims 8-12 of U.S. Patent No. 6,723,954, Applicants traverse and assert as follows.

The present invention as claimed in Claim 1 requires a non-oxidizing Ar shielding atmosphere. Claim 8 of US 6,723,954 has no such requirement, and, in fact, nothing in that patent discloses, teaches or motivates one of ordinary skill in the art to use a non-oxidizing shielding atmosphere of pure Ar in a GMAW process with metal core electrodes. This is consistent with the teachings of that patent that the shielding mixtures are 75% Ar to 25% of carbon dioxide, or 90% Ar to 10% carbon dioxide. In fact, Claim 11 of that patent claims such an oxidizing mixture. Therefore, the Patent Office has not made a showing that Claims 1-2 of the present application could be found obvious over Claims 8-12 of US 6,723,954. It is respectfully requested that this rejection be withdrawn.

Applicants believe that the present application is in condition for allowance. A Notice of Allowance is respectfully solicited. Should any questions arise, the Examiner is encouraged to contact the undersigned.

Respectfully submitted,

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Table 3
Tension Test Requirements

AWS Classification A5.28	AWS Classification A5.28M	Shielding Gas[a]	Tensile Strength (minimum) psi	Tensile Strength (minimum) MPa	Yield Strength[b] (minimum) psi	Yield Strength[b] (minimum) MPa	Elongation[b] Percent (minimum)	Testing Condition
ER70S-B2L E70C-B2L ER70S-A1	ER49S-B2L E49C-B2L ER49S-A1	Argon/1–5% O_2 (Classes SG-AO-1 thru SG-AO-5)	75 000	515	58 000	400	19	PWHT[c]
ER80S-B2 E80C-B2	ER55S-B2 E55C-B2		80 000	550	68 000	470	19	
ER80S-B3L E80C-B3L	ER55S-B3L E55C-B3L		80 000	550	68 000	470	17	
ER90S-B3 E90C-B3	ER62S-B3 E62C-B3		90 000	620	78 000	540	17	
ER80S-B6	ER55S-B6		80 000	550	68 000	470	17	
E80C-B6	E55C-B6		80 000	550	68 000	470	17	
ER80S-B8	ER55S-B8		80 000	550	68 000	470	17	
E80C-B8	E55C-B8		80 000	550	68 000	470	17	
ER90S-B9	ER62S-B9	Argon/5% O_2 (Class SG-AC-5)	90 000	620	60 000	410	16	
E90C-B9	E62C-B9	Argon/5–25% CO_2 (Classes SG-AC-5 thru SG-AC-25)						
E70C-Ni2	E49C-Ni2	Argon/1–5% O_2 (Classes SG-AO-1 thru SG-AO-5)	70 000	490	58 000	400	24	PWHT[c]
ER80S-Ni1 E80C-Ni1	ER55S-Ni1 E55C-Ni1		80 000	550	68 000	470	24	As-Welded
ER80S-Ni2 E80C-Ni2 ER80S-Ni3 E80C-Ni3	ER55S-Ni2 E55C-Ni2 ER55S-Ni3 E55C-Ni3		80 000	550	68 000	470	24	PWHT[c]
ER80S-D2	ER55S-D2	CO_2 (Class SG-C)	80 000	550	68 000	470	17	As-Welded
ER90S-D2 E90C-D2	ER62S-D2 E62C-D2	Argon/1–5% O_2 (Classes SG-AO-1 thru SG-AO-5)	90 000	620	78 000	540	17	
ER100S-1	ER69S-1	Argon/2% O_2 (Class SG-AO-2)	100 000	690	88 000	610	16	
ER110S-1	ER76S-1		110 000	760	95 000	660	15	
ER120S-1	ER83S-1		120 000	830	105 000	730	14	
E90C-K3	E62C-K3	Argon/5–25% CO_2 (Classes SG-AC-5 thru SG-AC-25)	90 000	620	78 000	540	18	
E100C-K3	E69C-K3		100 000	690	88 000	610	16	
E110C-K3 E110C-K4	E76C-K3 E76C-K4		110,000	760	98 000	680	15	
E120C-K4	E83C-K4		120 000	830	108 000	750	15	
E80C-W2	E55C-W2		80 000	550	68 000	470	22	

R = rod or solid wire

(continued)

c = composite or metal cored

Table 3 (Continued)
Tension Test Requirements

AWS Classification			Tensile Strength (minimum)		Yield Strength[b] (minimum)		Elongation[b] Percent (minimum)	Testing Condition
A5.28	A5.28M	Shielding Gas[a]	psi	MPa	psi	MPa		
ER70S-G E70C-G	ER49S-G E49C-G	(d)	70 000	490	(e)	(e)	(e)	(e)
ER80S-G E80C-G	ER55S-G E55C-G	(d)	80 000	550	(e)	(e)	(e)	(e)
ER90S-G E90C-G	ER62S-G E62C-G	(d)	90 000	620	(e)	(e)	(e)	(e)
ER100S-G E100C-G	ER69S-G E69C-G	(d)	100 000	690	(e)	(e)	(e)	(e)
ER110S-G E110C-G	ER76S-G E76C-G	(d)	110 000	760	(e)	(e)	(e)	(e)
ER120S-G E120C-G	ER83S-G E83C-G	(d)	120 000	830	(e)	(e)	(e)	(e)

Notes:
a. The use of a particular shielding gas for classification purposes shall not be construed to restrict the use of other gas mixtures. A filler metal tested with other gas blends, such as Argon/O_2 or Argon/CO_2 may result in weld metal having different strength and elongation. Classification with other gas blends shall be as agreed upon between the purchaser and supplier.
b. Yield strength at 0.2% offset and elongation in 2 in [51 mm] gage length.
c. Postweld heat-treated condition in accordance with Table 7.
d. Shielding gas shall be as agreed to between purchaser and supplier.
e. Not specified (as agreed to between purchaser and supplier).

6. Rounding-Off Procedure

For the purpose of determining conformance with this specification, an observed or calculated value shall be rounded to the nearest 1000 psi [10 MPa] for tensile and yield strength, and to the "nearest unit" in the last right-hand place of figures used in expressing the limiting value for other quantities in accordance with the rounding-off method given in ASTM E 29.

Part B
Tests, Procedures, and Requirements

7. Summary of Tests

7.1 The tests required for each classification are specified in Table 5. The purpose of these tests is to determine the chemical composition, the mechanical properties, and soundness of the weld metal. The base metal for the weld test assemblies, the welding and testing procedures to be employed, and the results required are given in Sections 9 through 13. See Section A4.2 in the Annex for requirements for classification based on gas tungsten arc welding (GTAW) only.

7.2 The optional test for diffusible hydrogen in Section 14, Diffusible Hydrogen Test, is not required for classification. See Note (a) of Table 5.

8. Retest

If the results of any test fail to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens for retest may be taken from the original test assembly or from one or two new test assemblies. For chemical analysis, retest need be only for those specific elements that failed to meet their requirement. If the results of one or both retests fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this specification for that classification.

A5. Ventilation During Welding

A5.1 Five major factors govern the quantity of fumes in the atmosphere to which welders and welding operators are exposed during welding:

(1) Dimensions of the space in which welding is done (with special regard to the height of the ceiling)

(2) Number of welders and welding operators working in that space

(3) Rate of evolution of fumes, gases, or dust, according to the materials and processes used

(4) The proximity of the welders or welding operators to the fumes as the fumes issue from the welding zone, and to the gases and dusts in the space in which they are working

(5) The ventilation provided to the space in which the welding is done

A5.2 American National Standard Z49.1, *Safety in Welding, Cutting, and Allied Processes* (published by the American Welding Society), discusses the ventilation that is required during welding and should be referred to for details. Attention is drawn particularly to the Section on Health Protection and Ventilation in that document.

A6. Welding Considerations

A6.1 Gas metal arc welding (GMAW) can be divided into three categories based on the mode of metal transfer. These modes are (1) spray (conventional or pulsed), (2) globular, and (3) short circuiting transfer. In the spray, pulsed spray, and globular modes, transfer occurs as distinct droplets that are detached from the electrode, transferring along the arc column into the weld pool. In the short circuiting mode, the metal is deposited during frequent short circuiting of the electrode in the molten pool.

A6.2 Spray Transfer

A6.2.1 The spray transfer mode, for carbon steel, is most commonly obtained with argon shielding gas mixtures with up to 5% of oxygen (AWS A5.32 Class SG-AO-X, where X is 1 to 5) or up to 15% carbon dioxide (AWS A5.32 Class SG-AC-Y, where Y is 5 to 15). A characteristic of these shielding gas mixtures is the smooth arc plasma through which hundreds of very fine droplets are transferred to the weld pool each second.

A6.2.2 Spray transfer with argon-oxygen (AWS A5.32 Class SG-AO-X) or argon-carbon dioxide (AWS A5.32 Class SG-AC-Y) shielding gas is, primarily, a function of current density, polarity, and resistance heating of the electrode. The high droplet rate (approximately 250 droplets per second) develops suddenly above a critical current level, commonly referred to as the transition current (for each size of electrode). Below this current, the metal is transferred in drops generally larger in diameter than the electrode and at a rate of from 10 to 20 per second (globular transfer). The transition current is also dependent, to some extent, on the chemical composition of the electrode. For 1/16 in [1.6 mm] diameter carbon steel electrodes, a transition current of 270 amperes (direct current, electrode positive [dcep]) is common. Alternating current is not recommended for this type of welding because it does not produce a stable arc.

A6.2.3 Pulsed Spray. Metal transfer in pulsed spray welding is similar to that of the spray transfer described above, but it occurs at a lower average current. The lower average current is made possible by rapid pulsing of the welding current between a high level, where metal will transfer rapidly in the spray mode, and a low level, where no transfer will take place. At a typical rate of 60 to 120 pulses per second, a melted drop is formed by the low current arc, which is then "squeezed off" by the high current pulse. This permits all-position welding.

A6.3 Globular Transfer. The mode of transfer that characterizes 100% CO_2 (AWS A5.32 Class SG-C) as a shielding gas is globular. Common practice with globular transfer is to use low arc voltage to minimize spatter. This shortens the arc length causing the arc to be "buried" and results in deeper penetration and better containment of spatter within the weld pool. Electrodes of 0.045 in through 1/16 in [1.2 mm through 1.6 mm] diameter normally are used at welding currents in the range of 275 to 400 amperes (dcep), for this type of transfer. The rate at which droplets (globules) are transferred ranges from 20 to 70 per second, depending on the size of the electrode, the amperage, polarity, and arc voltage.

A6.4 Short Circuiting Transfer. This mode of transfer is obtained with small diameter electrodes (0.030 to 0.045 in [0.8 to 1.2 mm]) using low arc voltages and amperages, and a power source designed for short circuiting transfer. The electrode short-circuits to the weld metal, usually at a rate of from 50 to 200 times per second. Metal is transferred with each short circuit, but not across the arc. Short circuiting gas metal arc welding of carbon steel is done most commonly with mixtures of argon and CO_2 (AWS A5.32 Class SG-AC-Y) as the shielding gas or with CO_2 (AWS A5.32 Class SG-C) alone. The penetration of such welds is greater with CO_2 than it is with argon-CO_2 mixtures. Mixtures of 50% to 80% argon with CO_2 remainder (AWS A5.32 Class SG-AC-Y, where Y is 20 to 50) can be advantageous for thin material. However shielding gas mixtures of 50% to 70% argon with CO_2 remainder (AWS A5.32 Class SG-AC-Y, where Y is 30 to 50) are unstable in the gaseous state and must be mixed from single gas components immediately prior to use. They provide low penetration, higher short